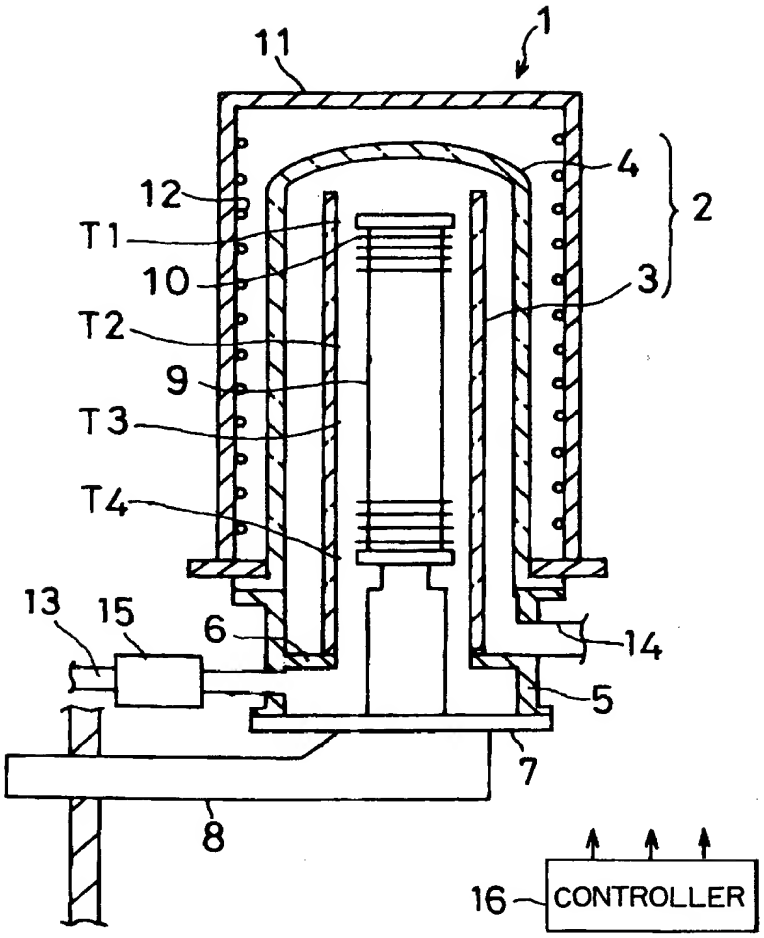

FIG. 1

TEMPERATURE OF HEATING UNIT \ COMPONENT	N_2O	N_2	O_2	NO	NO_2
1000 °C	1	47	19	0.3	3.0
900 °C	8	40	17	0.2	2.0
750 °C	54	28	13	0.05	0.5

(%)

FIG. 2

	FILM THICKNESS	Peak N VOLUME
EMBODIMENT	2.00nm	2.24atomic %
COMPARATIVE EXAMPLE 1	3.36nm	2.33atomic %
COMPARATIVE EXAMPLE 2	2.00nm	0.87atomic %

FIG. 3

	T1	T2	T3	T4
EMBODIMENT	798.6	800.2	800.1	802.6
COMPARATIVE EXAMPLE 3	798.4	800.1	799.9	801.8

(°C)

FIG. 4

PROCESSING CONDITION \ TEMPERATURE OF REACTION TUBE		750 °C	800 °C	850 °C
HEATING UNIT 900 °C	THICKNESS INCREMENT	0.29	0.50	0.90
REACTION TIME 15 MIN	PEAK N VOLUME	0.55	1.05	1.53
HEATING UNIT 1000 °C	THICKNESS INCREMENT	0.28	0.47	0.88
REACTION TIME 15 MIN	PEAK N VOLUME	1.13	1.24	1.66
HEATING UNIT 1000 °C	THICKNESS INCREMENT	0.36	0.75	1.09
REACTION TIME 30 MIN	PEAK N VOLUME	0.78	1.72	1.83
HEATING UNIT NOT HEATED	THICKNESS INCREMENT	0.30	0.54	1.01
REACTION TIME 15 MIN	PEAK N VOLUME	0.21	0.36	0.52

(THICKNESS INCREMENT : nm, PEAK N VOLUME : atomic %)

FIG. 5

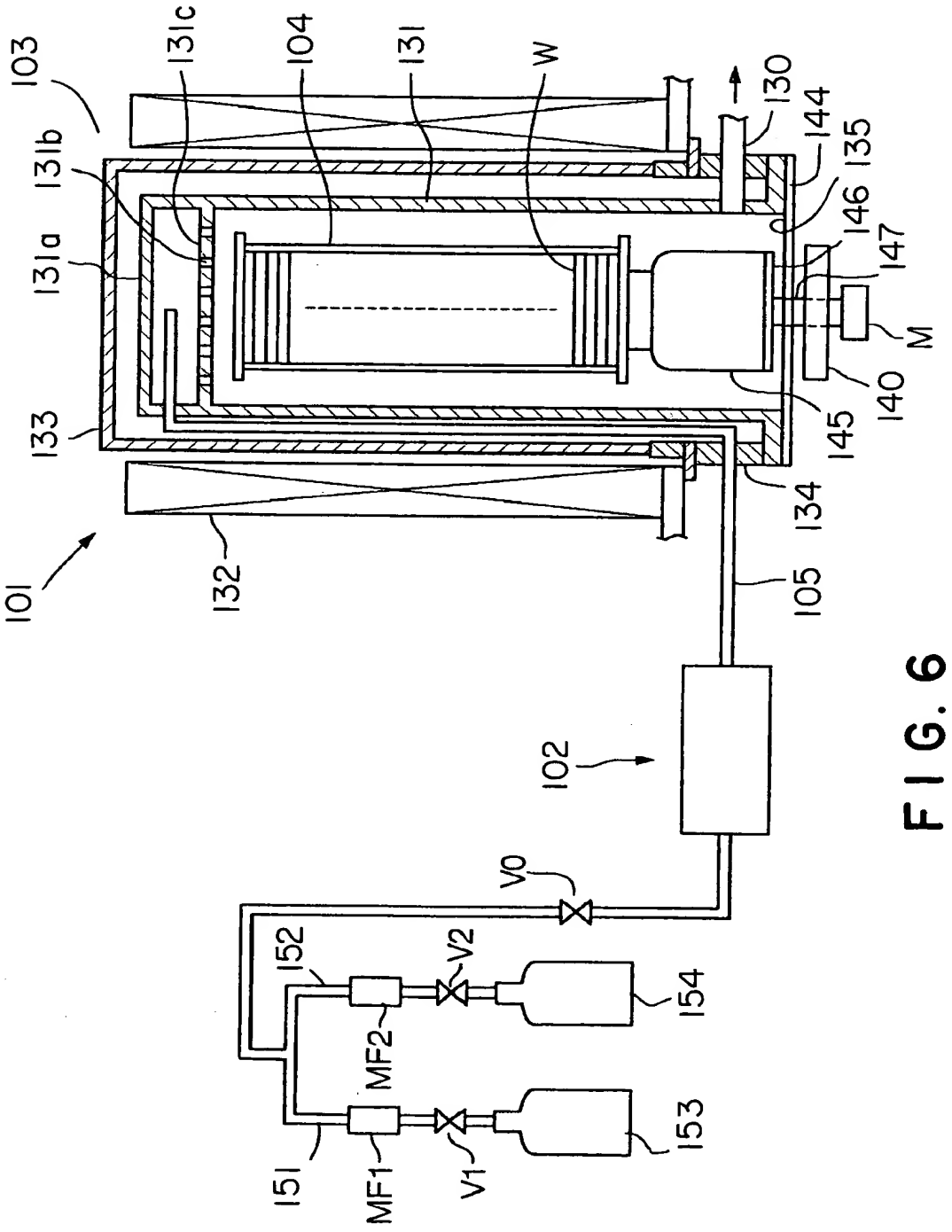
103
131c
104
131
W
130
144
135
131b
146
131a
147
M
133
140
145
134
101
132
105
102
V0
152
V2
154
MF2
153
151
MF1
V1

FIG. 6

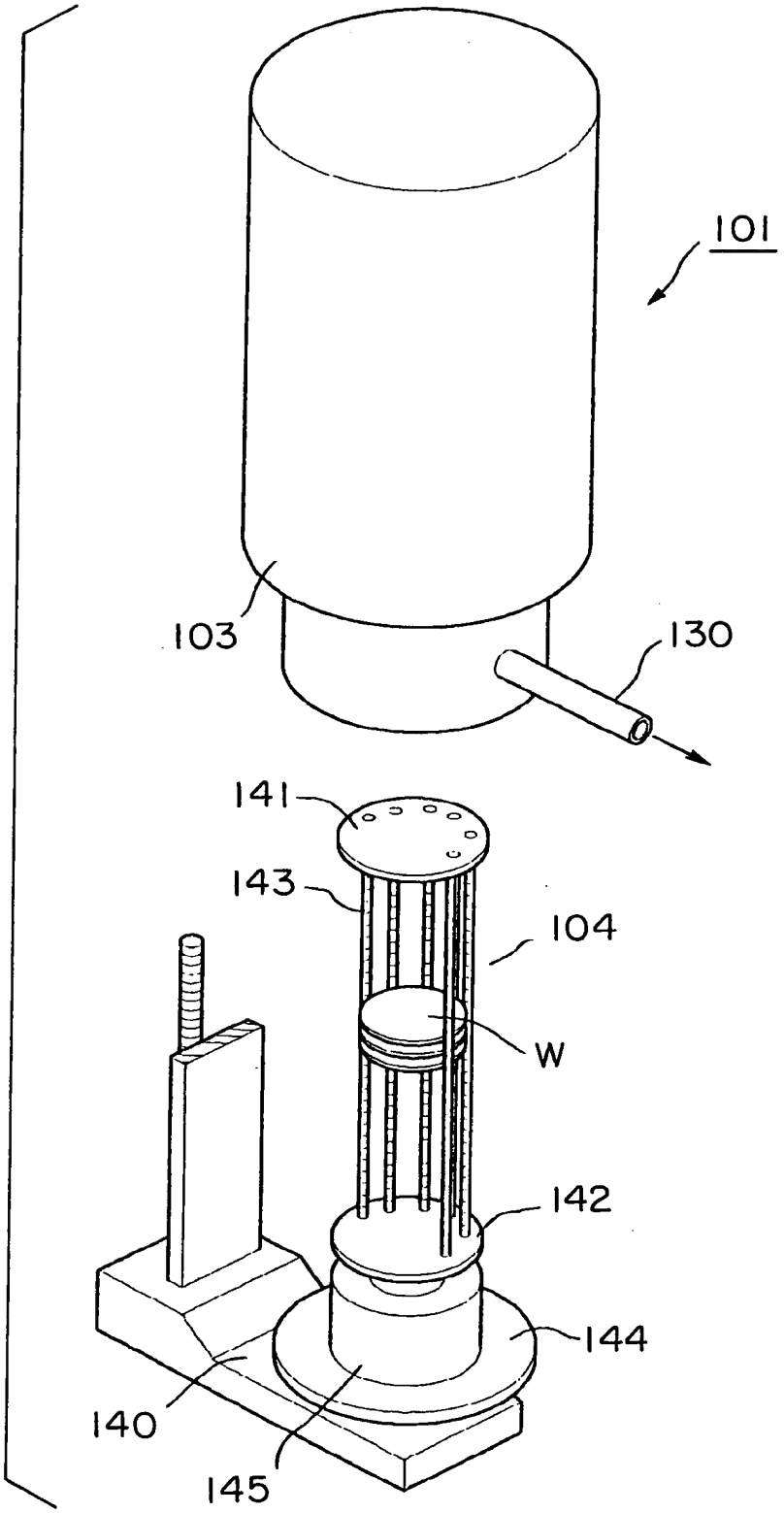

FIG. 7

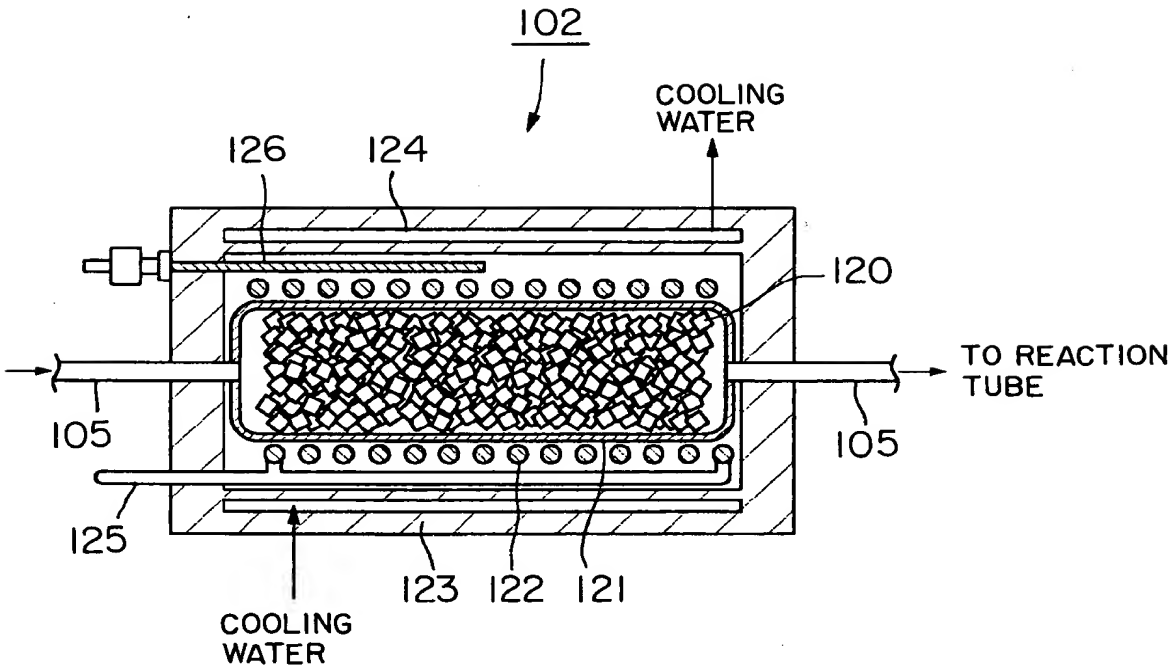
102
COOLING WATER
126
124
120
TO REACTION TUBE
105
105
125
123
122
121
COOLING WATER

FIG. 8

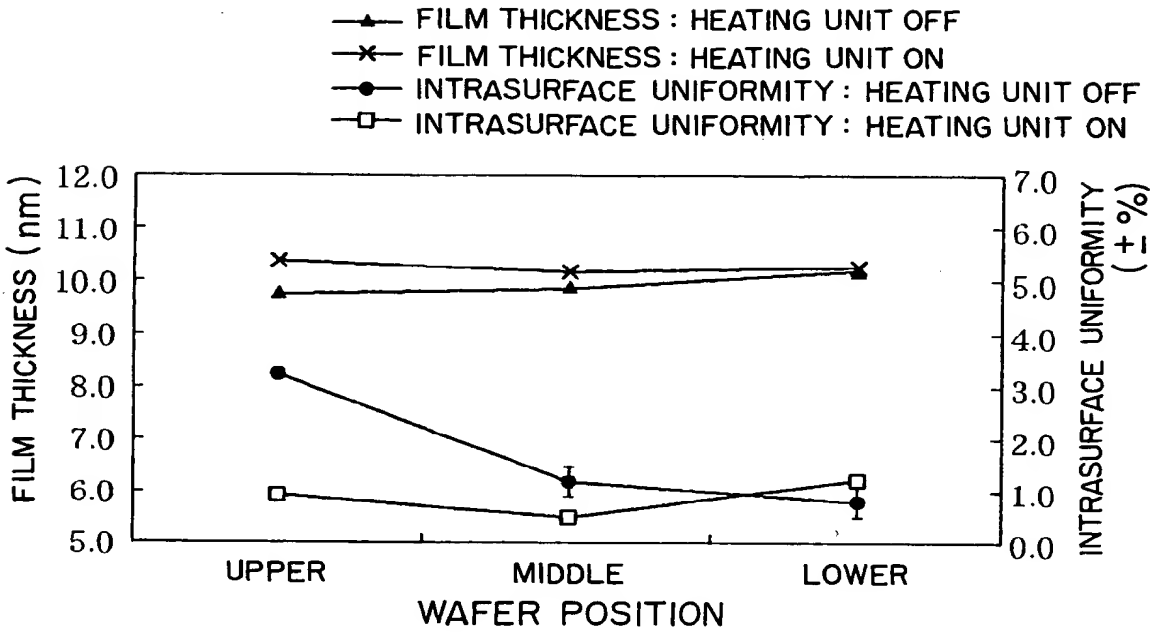
FILM THICKNESS : HEATING UNIT OFF
FILM THICKNESS : HEATING UNIT ON
INTRASURFACE UNIFORMITY : HEATING UNIT OFF
INTRASURFACE UNIFORMITY : HEATING UNIT ON
FILM THICKNESS (nm)
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
INTRASURFACE UNIFORMITY (±%)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
UPPER
MIDDLE
LOWER
WAFER POSITION

FIG. 9

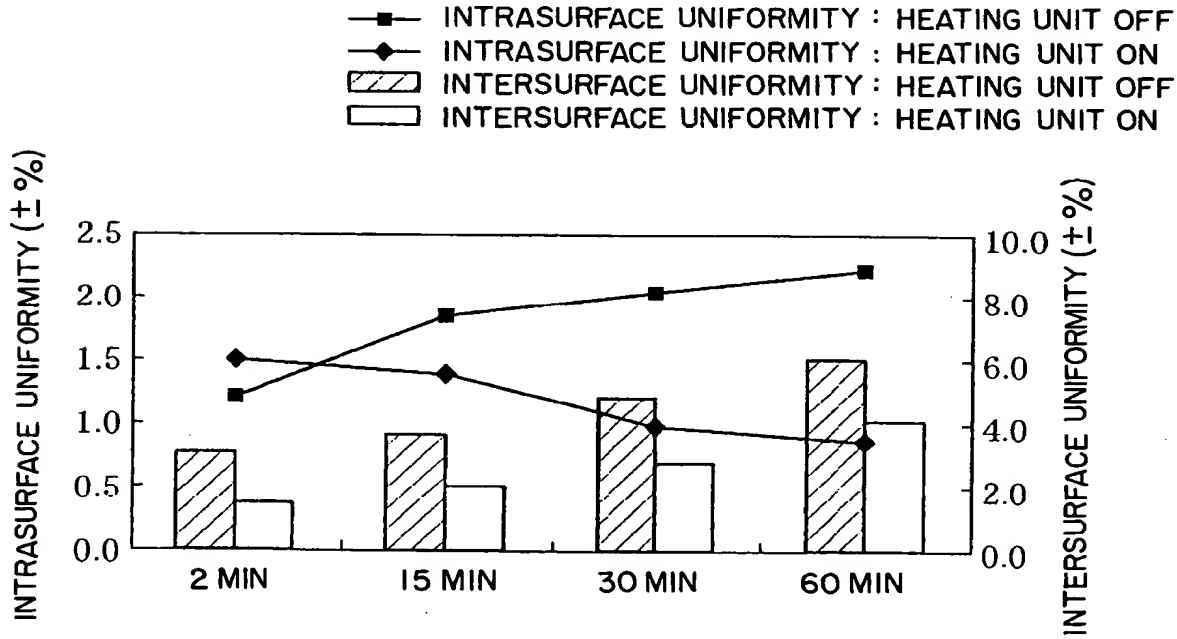
INTRASURFACE UNIFORMITY : HEATING UNIT OFF
INTRASURFACE UNIFORMITY : HEATING UNIT ON
INTERSURFACE UNIFORMITY : HEATING UNIT OFF
INTERSURFACE UNIFORMITY : HEATING UNIT ON
INTRASURFACE UNIFORMITY (±%)
2.5
2.0
1.5
1.0
0.5
0.0
INTERSURFACE UNIFORMITY (±%)
10.0
8.0
6.0
4.0
2.0
0.0
2 MIN
15 MIN
30 MIN
60 MIN

FIG. 10

Test No.	HEATING UNIT	ANALYSIS STARTING TIME (min)	H_2 DENSITY (ppm)
①	ON	30	<5
②		50	<5
③	OFF	30	23
④		50	78
⑤		70	24

FIG. 11

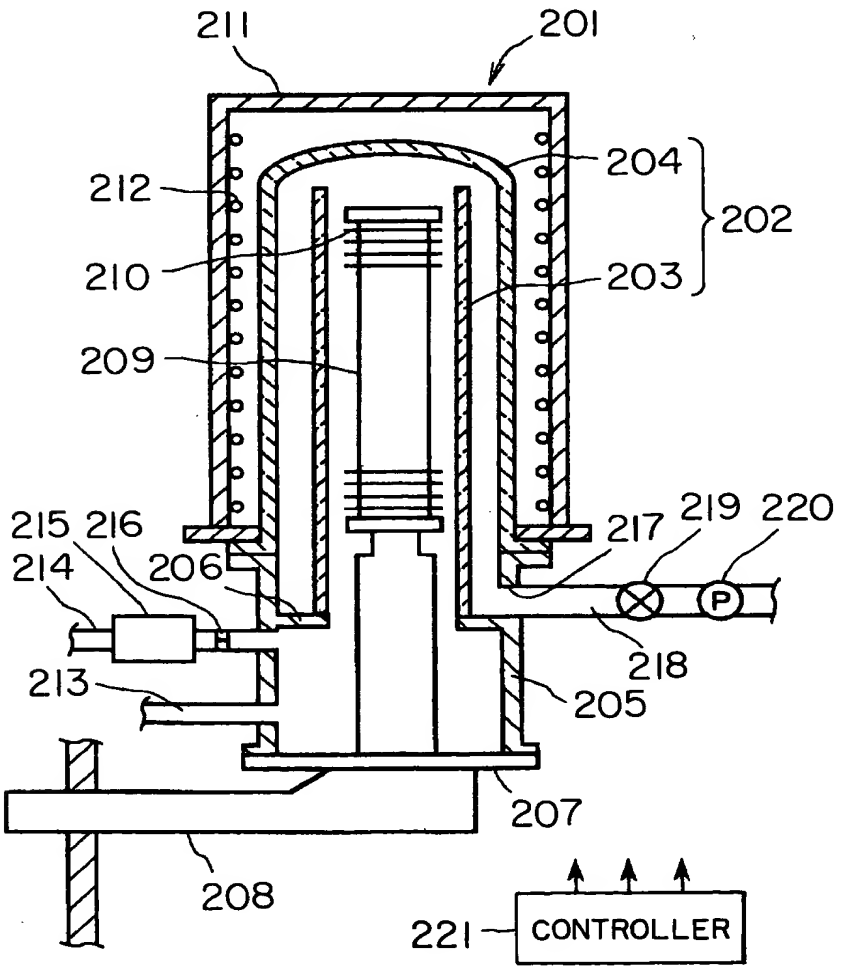

FIG. 12

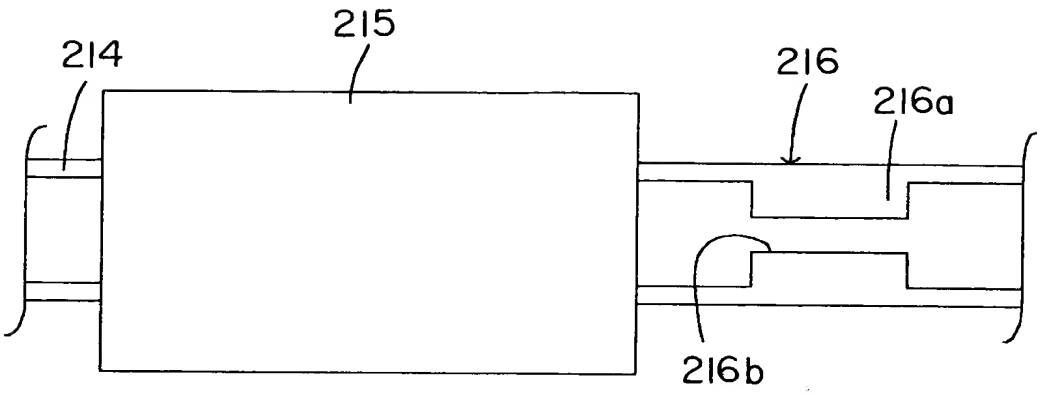

FIG. 13

	TEMPERATURE OF REACTION TUBE	D/R	RI
EMBODIMENT	550 °C	0.70nm/min	2.0
COMPARATIVE EXAMPLE	550 °C	0.27nm/min	2.9

FIG. 14

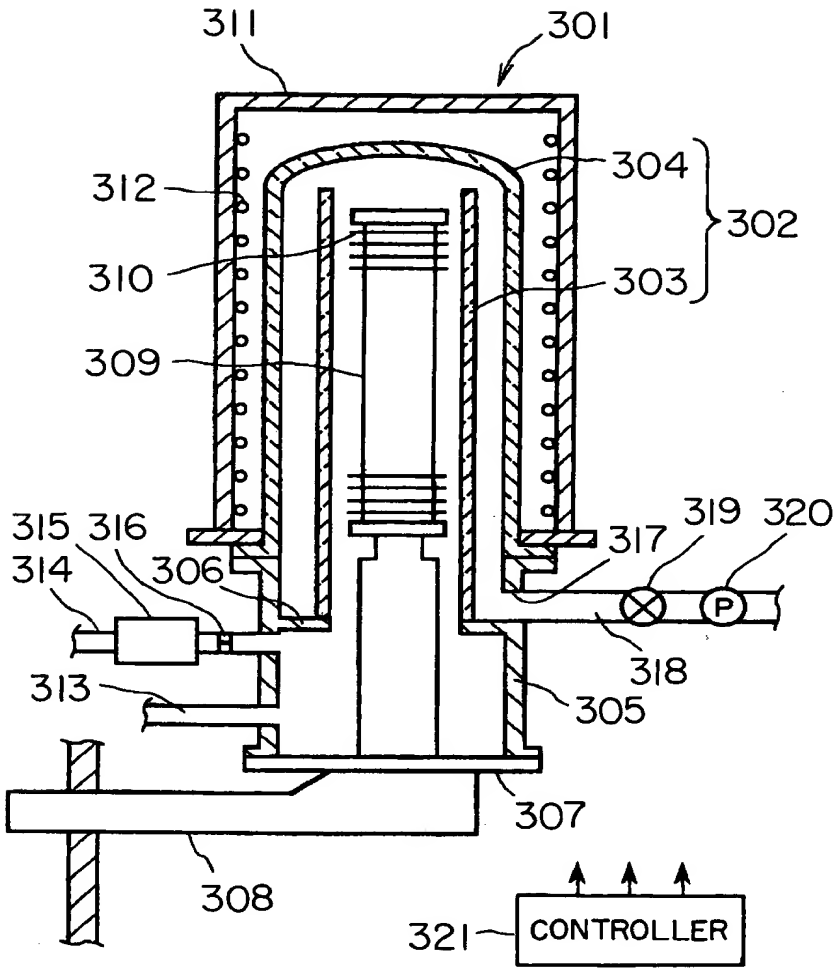
311
301
304
312
302
310
303
309
315
316
319
320
317
314
306
P
318
313
305
307
308
321
CONTROLLER

FIG. 15

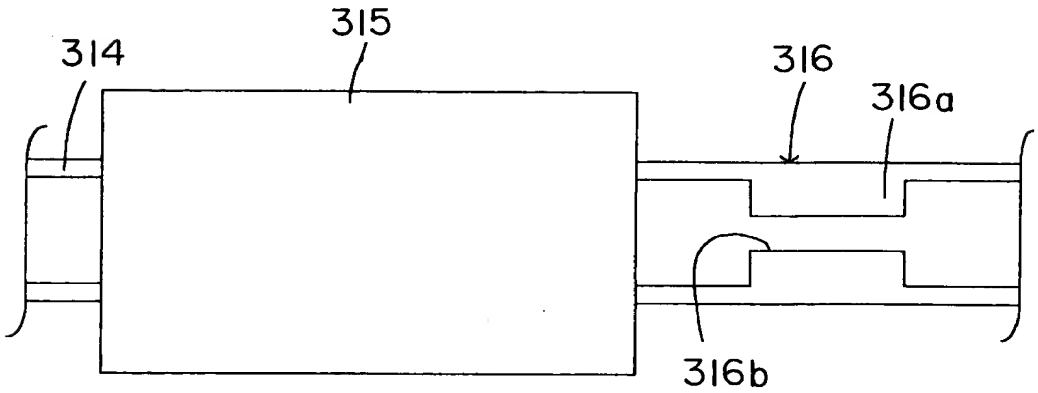
315
314
316
316a
316b

FIG. 16

TEMPERATURE OF HEATING UNIT	OXYGEN CONCENTRATION
600℃	5%
700℃	11%
750℃	13%
800℃	14%
900℃	17%
950℃	19%
1000℃	19%

FIG. 17

TEMPERATURE OF HEATING UNIT	FILM FORMING RATE
NOT HEATED	0.07nm/min
500℃	0.07nm/min
600℃	0.08nm/min
700℃	0.14nm/min
750℃	0.27nm/min
800℃	0.48nm/min
900℃	0.72nm/min
950℃	0.78nm/min
1000℃	0.78nm/min

FIG. 18

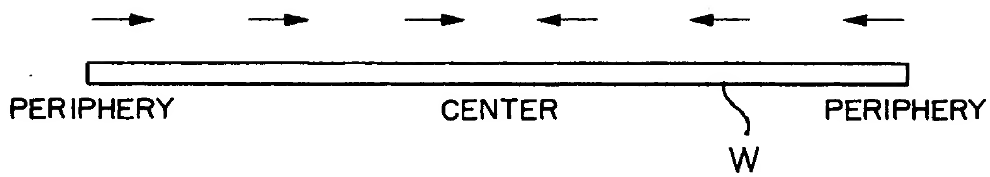

FIG. 19A

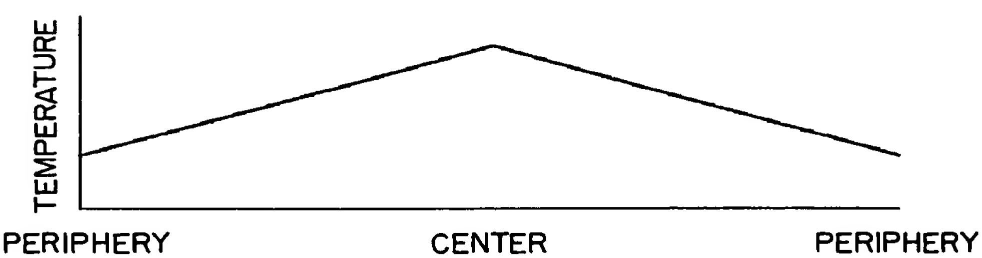

FIG. 19B

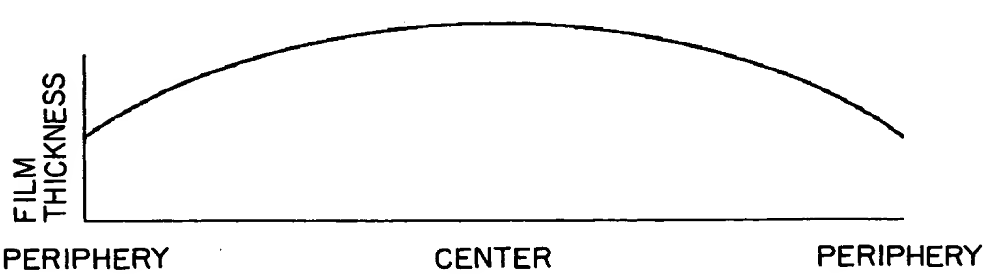

FIG. 19C